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QUARTERLY REPORT NO. 2

(FOR PERIOD ENDING FEBRUARY 28, 1975)

ENVIRONMENTAL BASELINE DATA COLLECTION
AND
MONITORING PROGRAM

FEDERAL PROTOTYPE OIL SHALE LEASING PROGRAM

TRACTS U-a and U-b

UTAH

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QUARTERLY REPORT #2

(For Period Ending February 28, 1975)

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ENVIRONMENTAL BASELINE DATA COLLECTION AND MONITORING PROGRAM

FEDERAL PROTOTYPE OIL SHALE LEASING PROGRAM

TRACTS U-a AND U-b, UTAH

Prepared For

WHITE RIVER SHALE PROJECT

Prepared By

VTN COLORADO

May, 1975

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I. INTRODUCTION

This document is a summary of "Quarterly Report No. 2" submitted by the White River Shale Project, lessees and operators of Federal Prototype Oil Shale Tracts U-a and U-b, Utah. This report documents activities which were conducted as part of the environmental baseline monitoring program between December 1, 1974 and February 28, 1975. The baseline program was conducted during this period in accordance with the "Partial Exploration Plan, Environmental Baseline Data Collection and Monitoring Element," submitted July 1, 1974; the Geologic Exploration Program, submitted August 28, 1974; and the Conditions of Approval developed by the Area Oil Shale Supervisor for various sub-elements of the program. Tracts U-a and U-b and the environmental monitoring stations are shown on Figure 1 (back pocket).

Seasonal conditions limited some monitoring and data collection activities on the tracts to a lower level of activity and frequency than would be typical during other portions of the year. Because of the extensive snow cover during most of the period, virtually no soils analysis could be performed and all historic and scientific resource surveys (archaeologic, paleontologic, and historic) were suspended. These activities will be resumed early in the third quarter as soon as weather permits.

The section describing the status of the "Fish and Wildlife Management Plan" has been deleted from this Quarterly Report.

The Plan has been submitted to the Area Oil Shale Supervisor in preliminary form and will be presented to the Oil Shale Environmental Advisory Panel as an informational document in May 1975. A copy of the final Fish and Wildlife Management Plan will be included in "Quarterly Report No. 3". The status of other special programs, such as revegetation, is also described in this report.

In general, this report includes activities which occurred between December 1, 1974, and February 28, 1975. For clarity, however, activities currently underway during the present quarter will be described under "Work Scheduled" as ongoing as of the date of this report. This format should lessen confusion regarding the actual phasing of program activities.

II. WATER RESOURCES

A. WORK COMPLETED

1. SURFACE WATER

During this quarter continuous water level recordings were collected at the surface water gaging stations and tabulated through February 28, 1975. (The surface water inventory presented in Table 1 includes the data collected from the surface gaging stations illustrated on Figure 1.) In addition to stream flow data, precipitation data collected from 14 standard and six automatic rain gauges have been forwarded to the USGS for computer processing.

Stream flow measurements were taken through the ice cover on the White River during the quarter; however, because of the difficulty in taking these measurements, a modified winter data collection program was initiated in cooperation with the USGS and with the agreement of the Oil Shale Supervisor (AOSS). This program involved concentrated data collection activities at Station S-3 on the White River near Watson (Ignatio Stage Stop) and the deletion of measurements at Stations S-1, S-4 and S-11 on the White River from December 15 to March 15.

2. SURFACE WATER QUALITY

Surface water quality sampling programs continued according to schedule, including analyses of sediment and total fecal

TABLE 1

SURFACE WATER INVENTORY

STATION S-3 (09306500) WHITE RIVER NEAR WATSON, UTAH

	DISCHARGE Cu.Ft/Sec.			TEMPERATURE Centigrade			CONDUCTIVITY Micro-Mhos/cm			PRECIPITATION Inches		
DAY	DEC.	JAN.	FEB.	DEC.	JAN.	FEB.	DEC.	JAN.	FEB.	DEC.	JAN.	FEB
1		290	390	0	0	0.80		986	850			
2		290	400	0	0	0.70		930	868			
3	271.	200	410	0	0	0.70	953	899	868	Trace		
4	304.	180	380	0	0.1	0.60	995	883	**			
5	397.	200	355	0	0.1	0.50	986	879				.14
6	461	230	370	0	0.1	0.40	885	879				
7	466	250	400	0	0.2	0.40	829	911			Trace	
8	431	230	*	0	0.2	0.40	800	907				
9	345	210		0	0.2	0.35	808	898				
10	336	200	416	0	0.3	0.35	842	888			.17	.03
11	200	230		0	0.3	0.40	885	854				
12	222	260	411	0	0.3	0.40	930	830				
13	249	300		0	0.35	0.30	972	825		.14		
14	324	340		0	0.35	0.20	1004	836				.07
15	324	350		0	0.35	0.10	996	852				
16	341	320		0	0.40	0.10	913	866				
17	354	320	396.	0.1	0.40	0.10	865	895				
18	345	350		0.1	0.40	0.10	843	890				
19	310	380	362	0.1	0.46	0.10	845	856				
20	250	360		0.1	0.46	0.10	847	827			Trace	
21	250	340	341	0.1	0.35	0.10	838	805				
22	220	325		0.2	0.25	0.48	818	805				
23	200	360		0.2	0.50	1.15	827	809				
24	240	400	306	0.2	1.1	0.91	842	821				
25	260	420		0.2	0.90	1.00	874	830				
26	300	450	358.	0.2	0.60	0.96	894	834				
27	300	475		0.1	0.30	0.94	919	840				
28	300	420		0.1	0.20	0.84	951	812			.52	
29	270	400		0.1	1.0		981	806		.02		
30	270	370		0.1	0.90		1024	823			Trace	
31	270	375		0	0.80		1026	840		Trace	.26	

* Discharge - From Feb. 7, data not returned from computer, spot measurements shown.

** Conductivity - From Feb. 4, data not returned from computer.

TABLE 1 (cont'd)

Stations S-2, S-6 and S-7 had little or no flow during this period due to freezing.

Note: Late report, rising temperatures on March 2 caused heavy snow melt and some runoff in ephemeral streams. The following are estimated flows:

S-2	18. cfs
S-5	10. cfs
S-6	15. cfs
S-7	10. cfs
S-8	0.2 cfs
S-9	0.2 cfs
S-10	0
S-12	0.3 cfs
S-13	0.5 cfs
S-15	0

strep and coliform. A summary of these analyses is given in Table 2. Samples were taken from the White River and Evacuation Creek, the only live streams in the project area.

3. GROUND WATER

Draft copy maps have been completed showing the following:

1. Elevation of the top of the aquifer
2. Lines of equal specific conductance
3. Line of equal ground water elevation
4. Aquifer isopach
5. Relationship of the ground water surface to the top of the aquifer
6. Aquifer outcrops

Data refinement and field checking are required to finalize these maps.

Sample calculations of distance-drawdown relationships through time and with variations in quantity have been made. An average transmissivity derived from slug testing several wells (2646 gpd/ft) was used in the calculations, and a storage coefficient of 7×10^{-4} was assumed. The Theis (1935) non-equilibrium equation used by USGS was used for the calculations. Results suggest the following pumping rates would yield the best test results.

TABLE 2

SUMMARY OF SURFACE WATER SAMPLE ANALYSES[1]
(JANUARY AND FEBRUARY, 1975)

MONTH	STATION	TOTAL	FECAL	FECAL STREP	$\frac{FC}{FS}$ RATIO[2]
	S-1	64	50	34	1.5
JANUARY	S-3	64	50	17	2.9
	S-4	26	34	17	2.0
	S-11	40	23	23	1.0
	S-1	114	20	17	1.2
	S-2	0	0	1	-
FEBRUARY	S-3	175	16	32	0.5
	S-4	104	22	20	1.1
	S-6	0	0	25	$0.05^{\pm}$
	S-11	134	21	37	0.6

[1] All Values per 100 ML

[2] $\frac{\text{FECAL COLIFORM}}{\text{FECAL STREP}}$ = RATIO

SOURCE: Prepared by VTN

Well No.	Pumping Rate
P-1	40 gpm
P-2 upper	35 gpm
P-2 lower	350 gpm
P-3	5 gpm

Actual six-hour step drawdown tests are scheduled at each site prior to the aquifer tests to more accurately determine the maximum sustained pumping rate.

Preliminary calculations using the Theis nonequilibrium formula (1935), suggest a drawdown at the P-1 site of 0.4 feet to be observed at one of three monitoring wells within a mile radius of P-1. Pumping of the P-1 aquifer at 40 gpm will create this drawdown within a maximum period of 15 days.

Calculations also suggest the drawdown at the P-2 site (lower aquifer) will be limited to the observation wells within 150 feet because no other adequate monitoring points where identified within a one-mile radius of the site on the basis of a survey of the area. (G-21 is the only aquifer well within a mile radius of P-2 lower and would only give a one directional transmissivity at best.) Ten days of pumping should be sufficient to determine the transmissivity at the site and to identify any potential hydraulic interconnection with the White River. Pumping of the P-2 upper aquifer should be limited to three days to distribute drawdown across the site and to establish transmissivity.

The aquifer at the P-3 site is about 25 percent saturated and a very low production rate of three to five gallons per minute is expected. Adjusting the aquifer characteristics for non-saturation, it was calculated that about 16,000 days of continuous pumping will be required to achieve 0.5 feet of drawdown at a one-mile distance.

4. GROUND WATER QUALITY

Ground water samples were collected in December and January, 1975. A full set of analyses for all wells sampled in December is not yet available; however, samples from approximately 90 percent of the wells have been analyzed. The range in total dissolved solids residue derived from these data is from 878mg/l to 4530mg/l. Analyses of samples collected in January will be available accompanying Quarterly Report #3, June, 1975.

B. DATA SUMMARY

1. SURFACE WATER

Table 1 summarizes data collected, including daily tabulations of discharge, temperature, and conductivity. During the second quarter, the installed turbidity meters were removed due to severe icing. These meters will be replaced when climatic conditions permit.

2. SURFACE WATER QUALITY

Surface water quality data compiled include chemical and biological analysis of samples collected monthly during the period from

August 28, 1974, through February 4, 1975. Additional data was gathered from a continuous monitoring program at 14 surface stations, including specific conductance, flow, and temperature.

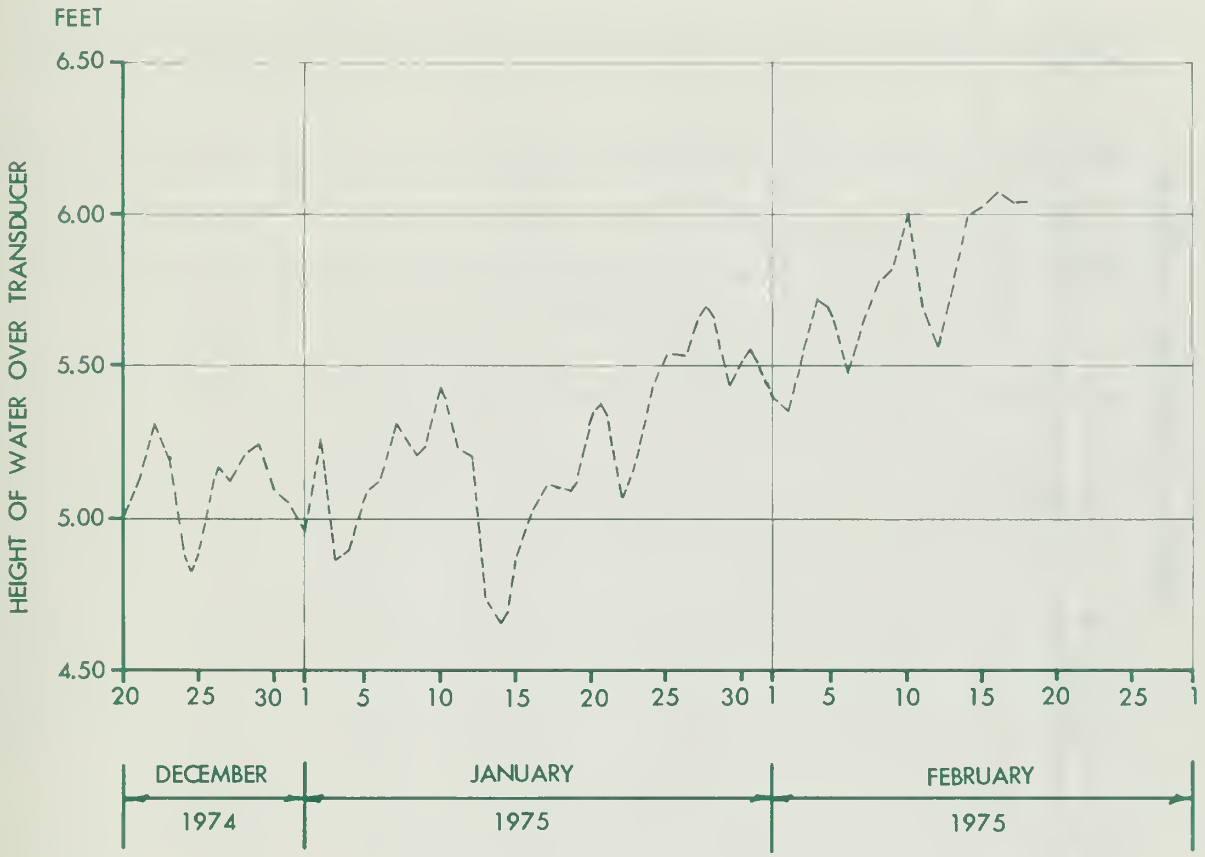
3. GROUND WATER

Water levels have been measured monthly in all holes on and around the tracts since November, 1974. Some marked fluctuations were recorded in the November-December measurements, but drilling activities were still underway which may have caused the extremely large fluctuations.

Data are now available for the continuous water level recorders at the P-1, P-2 upper, P-2 lower, and P-3 sites. Some wide fluctuations were observed early in the program at Hole P-3 owing to water accumulation in the pressure transducer, but this was soon corrected. Graphs showing the water levels recorded for each well during the reporting period are included in Figures 2 through 5.

Water levels at the P-1 site fluctuated approximately a foot during the period from December 20 to January 22, 1975. After January 22 the water level began to climb steadily through the end of the available record on February 18. The net rise in water level during the period was about 1 foot.

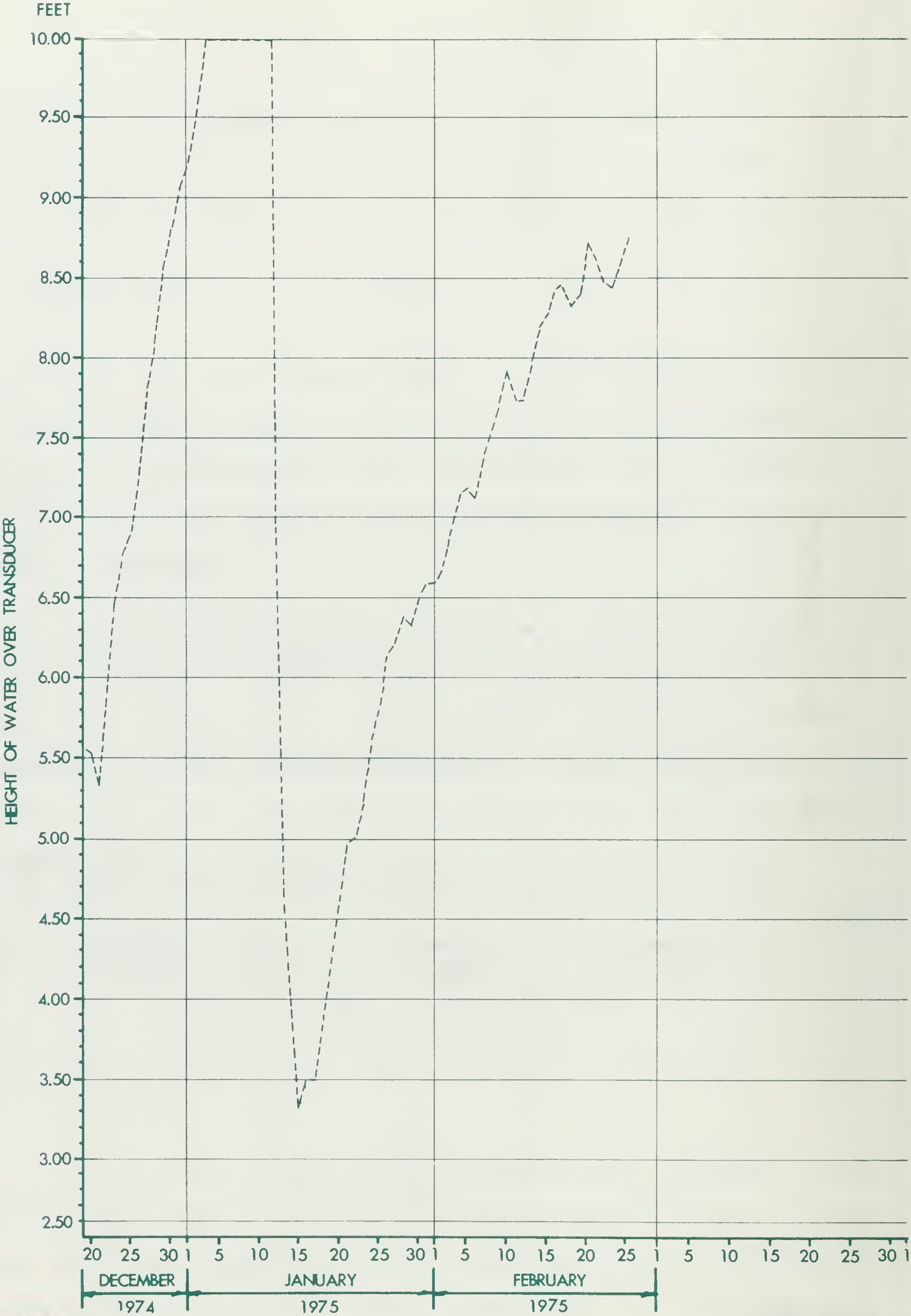
The record of the P-2 upper aquifer demonstrates the widest fluctuation in water level. The record begins December 19 and by January 2 the water had risen more than 4.46 feet and exceeded the capabilities of the equipment. The water level dropped into the range of



CONTINUOUS MONITORING WELL

P-1

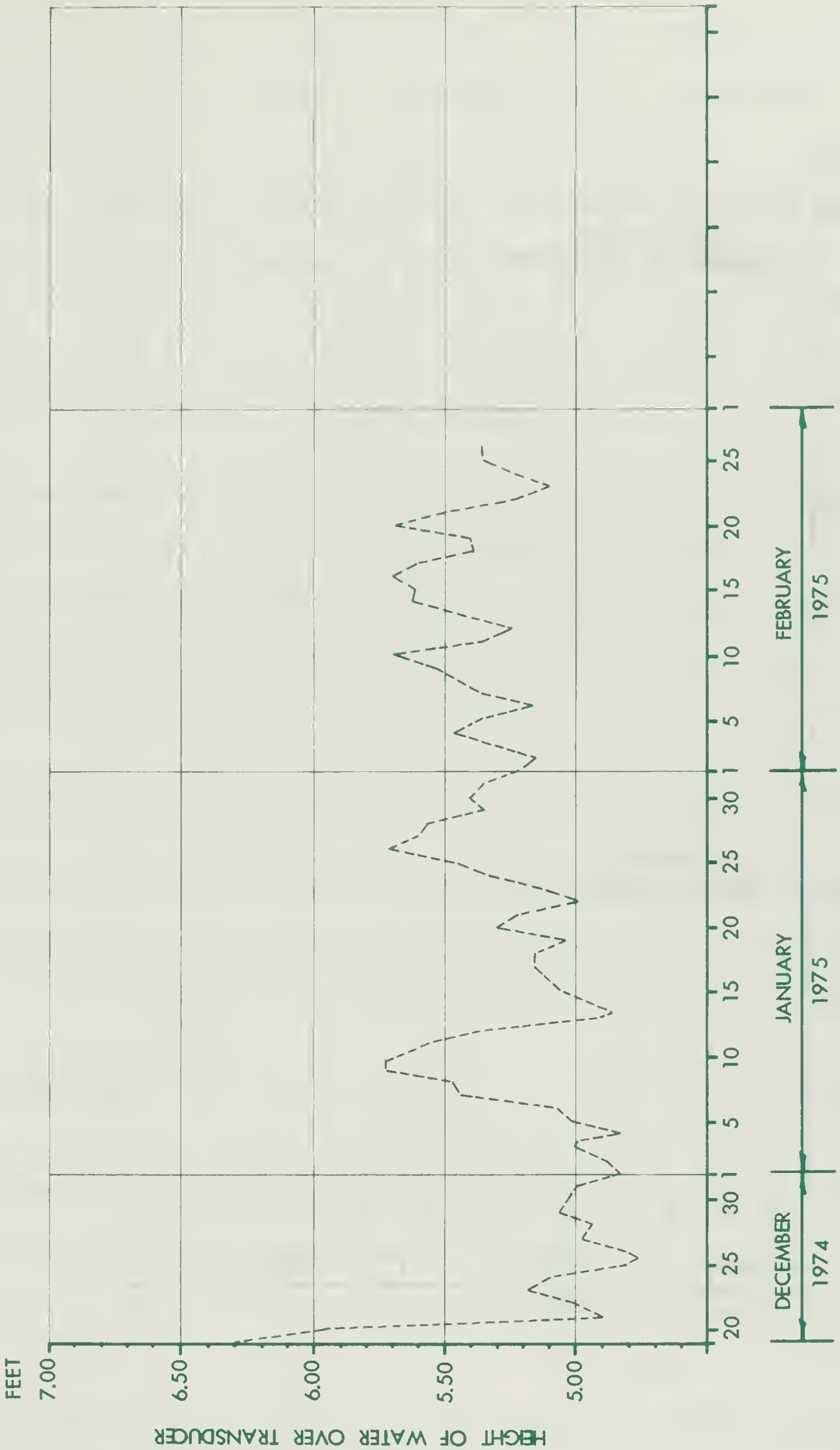
FIGURE 2



CONTINUOUS MONITORING WELL

P-2 UPPER

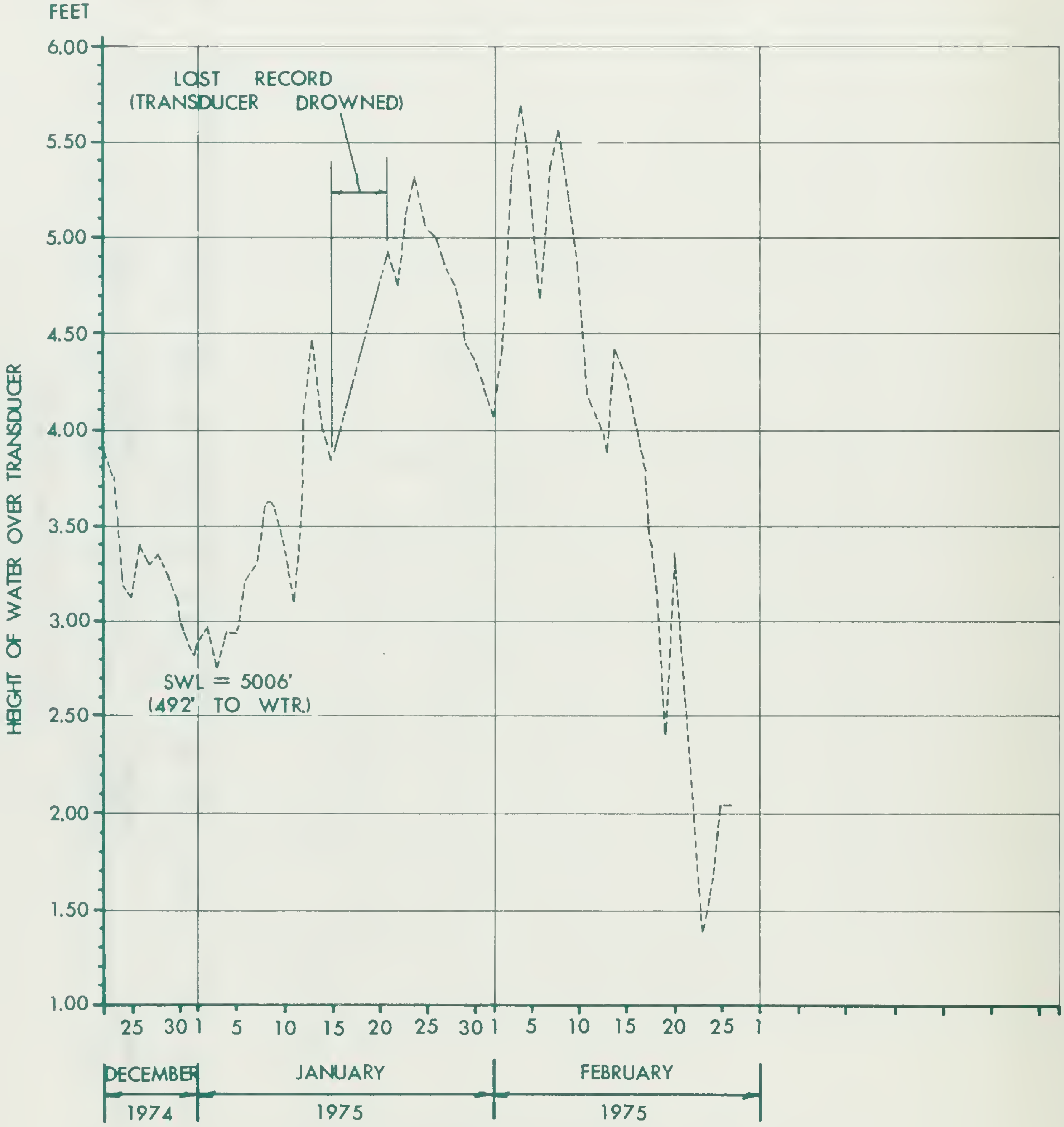
FIGURE 3



CONTINUOUS MONITORING WELL

P-2 LOWER

FIGURE 4



CONTINUOUS MONITORING WELL

G-7 (P-3 SITE)

FIGURE

the equipment on January 11 and dropped sharply 6.60 feet to a low on January 15. The water table began to rise gradually and by the end of the available record on February 26, 5.42 feet had been regained. The pressure transducer utilized has been recalibrated to accomodate a wider fluctuation range.

The P-2 lower record is very stable and gained only 0.5 feet during the period from December 20 to February 26, 1975.

The record at the P-3 site indicates fluctuations of one foot or more a day, but generally indicates a major high water period (January 3 to February 8, 1975) bounded by lows. The maximum water level fluctuation recorded during the period of record was 4.28 feet.

4. GROUND WATER QUALITY

The analysis results for the samples collected in November and December have been analyzed by the USGS labs in Salt Lake and Denver.

C. WORK SCHEDULED

1. SURFACE WATER AND SURFACE WATER QUALITY

Monitoring will continue according to the modified schedule until March 15 when it will revert back to the normal schedule of measurements every other day. On April 15 this will change to the spring peak runoff schedule which requires daily samples and measurements at each station.

During the next quarter, data reduction, statistical evaluation, and program refinement will continue concurrently with the on-going monitoring program. The technique and methodology which will be used to evaluate the local and regional surface hydrologic flow regimes will be defined in detail during the next quarter.

2. GROUND WATER

The aquifer test program is tentatively scheduled to begin in June, 1975, pending approval of discharge permit applications submitted to the EPA.

Field work is scheduled in late April or early May to verify the aquifer outcrop locations projected from structural data. This field work is intended to coincide and to supplement dye tracer studies of the alluvium in Evacuation Creek which will be conducted by the USGS. The dye studies are designed to provide a clearer understanding of the bedrock-alluvial aquifer interrelationships.

3. GROUND WATER QUALITY

The bedrock and alluvial wells containing water were sampled in March and submitted for analysis of the semi-annual list of parameters. The next pumped sample collection is scheduled for the late summer-fall period.

III. AIR RESOURCES

A. WORK COMPLETED

During the quarter ending February 28, 1975, all of the air quality monitoring activities included in the provisions of the lease were performed, supplemented by additional monitoring prescribed by the "Conditions of Approval" for the environmental baseline monitoring program or performed at the request of the lease operators.

At the beginning of the quarter equipment had been installed at nine of the 12 air quality/meteorology sites, but only one air quality station was operational due to electric generator failures. The malfunctioning generators were replaced early in December and by mid-month all five of the disabled stations were operating again and installations had been completed at the three sites which had not previously commenced operation.

In addition to continuous monitoring of the air quality and meteorology parameters required by the terms of the lease (i.e., SO_2, H_2S, suspended particulates, hydrocarbons, nitrogen oxides, wind, humidity, and temperature), certain additional measurement programs were begun during this quarter. These programs were either included in the "Conditions of Approval" of the environmental baseline monitoring program or were required by the lease operators because of their possible importance to a total environmental assessment.

The parameters measured at each station are indicated on Table 3. It should be noted that at most stations supplemental parameters are being monitored in addition to those required by the lease stipulations or "Conditions of Approval" as described above.

One of these, the trace metals program, began on January 29, 1975. Samples are collected by a multistage Lundgren impactor which segregates airborne particulates by size and collects them on two cascaded rotating drums and an after-filter. The particle size ranges collected on these three stages are: Stage 1 - about 20 microns to 3.6 microns; Stage 2 - 3.6 microns to 0.65 microns; Stage 3 - 0.65 microns to 0.1 microns. The rotation of the drums allows for chronological recording of the data; thus, unlike normal composite filter techniques, diurnal variability of particulate concentrations can be discerned.

Samples are normally collected for six consecutive days at the beginning of each month, except that during the first month of operation two sets of seven-day samples were collected (January 29 to February 5, and February 5 to 12).

TABLE 3

AIR RESOURCES BASELINE MEASUREMENT LOCATIONS

PARAMETER	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Mobile	COMMENTS
	SITE NUMBER													
Meteorology														
Wind Speed & Direction (10 m)	X	X	X	X	X	X	X	X	X	X	X	X	X	
Wind Speed & Direction (20 m)		X				X								
Wind Speed & Direction (30 m)		X				X								
Temperature (10 m)		X		X		X			X	X	X	X	X	
Lapse Rate (10-30 m)		X				X								
Relative Humidity (10 m)		X				X								
Lateral Turbulence (10 m)				X									X	
Lateral Turbulence (30 m)		X				X								
Vertical Turbulence (10 m)				X									X	
Vertical Turbulence (30 m)		X				X								
Net Thermal Radiation						X								
Barometric Pressure						X								
Acoustic Sounding						X								
Rawinsonde - T(h), RH(h)						X								Two soundings every 6th day
Air Quality														
Total Sulfur, SO_2, H_2S	X	X	X	X	X	X	X	X	X	X	X	X	X	
Suspended Particulates	X	X	X	X	X	X	X	X	X	X	X	X	X	24-hr sample every 6th day
Total Hydrocarbons, CH_4		X	X			X							X	
CO		X	X			X							X	
O_3		X	X			X							X	
NO, NO_x		X	X			X							X	
Coefficient of Haze		X												
Scattering Coefficient		X												
Visibility									X					Monthly Observation
Trace Metals		X				X								See Note (a)
Carcinogens		X												Monthly 24-hr sample
Size Fractionated Particulates		X												Monthly 24-hr sample
Radiology														
Radiation Level	X	X	X	X	X	X	X	X	X	X	X	X	X	See Note (b)
Radiation Dosage	X	X	X	X	X	X	X	X	X	X	X	X	X	
Radioactivity of Particulates		X				X								Quarterly composite sample
Noise														
Sound Level	X	X	X	X	X	X	X	X	X	X	X	X	X	See Note (c)

X denotes that the appropriate parameter is monitored at the given site. All measurements are continuous unless otherwise noted.

NOTES:
- (a) 24-hr sample every 6th day, alternating between Sites A2 and A6.
- (b) Pressurized ion chamber rotated between Sites A1-A12; stationed one week at each site. Site survey with hand-held scintillation counter and ion chamber before each installation of pressurized ion chamber.
- (c) Quarterly tract survey with hand-held survey meter.

These collected samples are currently being analyzed by the Crocker Nuclear Laboratories of the University of California at Davis, using ion-excited X-ray emission techniques for determining the concentrations of sodium and higher elements.

Soundings of upper atmospheric structure were begun on December 10, 1974, by means of a monostatic acoustic sounder. This instrument gives continuous semi-quantitative records of the presence of thermal plumes, stable layering, and inversions aloft to a height of 1000 meters above the ground. The system was converted to a monostatic bistatic system on February 20, thereby providing additional data on the degree of turbulence aloft between approximately 100 to 300 meters above the ground.

Complementing the continuous acoustic measurements, rawinsonde soundings of temperature and humidity up to 2 kilometers above the surface began on January 30 and have been taken twice daily, at sunrise and 1:00 P.M. every sixth day since that date (with additional soundings on certain days of interest described below).

Special experiments were conducted from February 19 to 21 to study the diffusive characteristics of the lower atmosphere on the tracts and to study the variability of ozone and suspended particulates within a 40-kilometer circle around the tracts.

During this period detailed measurements of atmospheric stability and turbulence were made three times daily from the top of the

100-foot tower at Station A-6 up to 14,000 feet MSL, using a specially-instrumented aircraft. Simultaneous rawinsonde launches provided independent temperature data plus humidity and wind profiles, while pilot balloon launches gave finer details of wind structure aloft.

During these experiments the diffusive capability of the atmosphere was observed by releasing colored smoke from a tethered balloon at 300 feet and observing the subsequent motion and decay of the smoke concentration from the ground (through photography). In addition the plume was probed by an aircraft equipped with an integrating nephelometer.

Ozone and particulate profiles were surveyed by aircraft. Low-level profiles were measured at an altitude of 7,000 feet MSL out to 25 miles from Station A-6 and in the area between Vernal and the tracts; and vertical profiles were recorded at Vernal, Station A-6, and at various locations 25 miles from Station A-6. The purpose of these measurements was to study the possible causes for the higher-than-normal background ozone levels in the area as well as to study the differences in ozone and particulate levels between the urbanized and underdeveloped areas studied.

Routine measurements of ambient radiation levels throughout the tracts began in January using a pressurized ion chamber which is rotated between all 12 air quality/meteorology sites. Since this instrument is left at each site for six days, one survey of the tract is completed every 72 days.

Commercial electric power was connected to the air quality Stations A-6 and A-8 in February, with plans for further installation to proceed in March and April, 1975. These electric power connections will solve the previous problems with erratic electric power and will also eliminate occasional contamination of the air by the generator exhaust.

B. DATA SUMMARY

Major statistical analysis of the data collected to date has not yet been attempted, pending collection of sufficient data for reliable analysis; thus the data will be discussed in general terms, summarizing highlights of the observations.

1. METEOROLOGY

The major climatic difference between this quarter and the previous one was considerably lower temperatures and snow cover for most of the period.

The lowest surface temperature recorded on the tract during this period was -38°C (-37°F) at 7:00 a.m. on January 12 at Station A-10, located in the White River channel. (All temperatures are measured at 10 meters above the ground). Corresponding temperatures at more elevated or exposed sites ranged from -29°C (-20°F) at Station A-12 to -13°C (9°F) at Station A-4.

The highest temperature was 15°C (59°F) at Station A-4, which is located at an exposed site on a ridge, at 3:00 p.m. on January 26. Corresponding temperatures at other sites ranged from 14°C (57°F) at Station A-6 down to 4°C (39°F) at the sheltered location of Station A-10.

Wind speeds during this period were on the average slightly greater (approximately 0.1 meter per second (m/s) or 0.2 mph) than those recorded during the previous reporting period (i.e., November). The highest hourly average wind speed was 16.4 m/s (36.5 mph) which was measured between 9 and 10 P.M. on December 21, 1974 at Station A-9, an exposed site on a ridge. In contrast, the maximum hourly average during the entire month of December was only 2.9 m/s (6.5 mph) at Station A-5, located at a highly sheltered site on the White River. Although dead calm (wind speeds below the anemometer threshold of 0.3 m/s) was recorded at various sites during the early morning hours, the wind at the most exposed sites never averaged less than 0.5 m/s (1 mph) during any hour in December, 1974, or January, 1975.

Overall, the highest monthly average wind speeds occurred at Station A-9, where the wind was predominantly from the west. Station A-11 was also quite windy, consistently averaging about 2.3 m/s (5.1 mph) during the entire course of the study to date. The prevailing winds at that station were from the southeast during the night and from the west-northwest during the day. Drainage flow at night and topographic channelization of the prevailing westerly wind aloft appear to maintain in the high average speed at this fairly exposed location.

The calmest locations were, as would be expected, along the bottoms of canyons, such as at Station A-5, which has been averaging 1.3 m/s, consistently from the north, and at Station A-10, where the values have been about 1.4 m/s, generally from the north-northwest. Also as expected. the calmest period was generally around dawn while the windiest conditions occurred in the afternoon.

The wind measurements during this period have continued to support the previous observation of great variability in wind direction and wind speed from site to site due to the complex topography of the study area.

The acoustic sounder shows that typically a surface-based inversion with a thickness of 150 to 200 meters develops during the night, often topped by a number of stable strata up to 300 to 500 meters in elevation. When the ground was snow-covered, this surface layer sometimes persisted through the whole day,with little erosion from below by thermals, while on other days thermal activity up to approximately 200 to 250 meters was noted at midday. Frequently, a stable layer aloft persisted throughout the whole day at about 300 meters. The rawinsonde observations, although providing a less comprehensive data base, support these general observations.

2. AIR QUALITY

Results of initial observations contained in the previous quarterly report continue to be supported by new data. Highlights of recent data and emergent trends are summarized in the following paragraphs.

The sulfur compound levels all remained near the threshold of detection of the instruments and are below any applicable air quality standards. An anomaly occurred between January 25 and 28 when the H_2S values at most sites approximately doubled from expected values to about 8 ug/m^3 (6 ppb). The cause for this increase is not known at this time.

One item of interest in the previous period was the observation of high ambient ozone values in excess of the Federal Air Quality Standard (160 ug/m^3 - 1 hour maximum). Such conditions continued to occur during this period but not as frequently and to a lesser degree.

The problem of contamination of hydrocarbon and carbon monoxide readings by generator exhaust during the first part of the quarter was solved during the last part by redesign of the exhaust system and by the connection of commercial electric power to some of the stations. The methane values, which were not affected by the exhaust, were generally about 1000 ug/m^3 (1.6 ppm). The uncontaminated CO levels were generally on the order of 600 ug/m^3 (0.5 ppm), an extremely low value, but the nonmethane hydrocarbon ambient level frequently exceeded the federal standards, (160 ug/m^3 - 3-hour average, 6 A.M. to 9 A.M.) with a typical level of about 350 ug/m^3 (0.5 ppm) methane equivalent.

Ambient levels of all oxides of nitrogen (NO_x) were always below 110 ug/m^3 NO_2 equivalent (0.06 ppm) and were usually less than a quarter of that value. NO_2 never exceeded 40 ug/m^3 (0.02 ppm) and was usually below 20 ug/m^3 (0.01 ppm).

Suspended particulate concentrations were generally below 10 ug/m^3 and occasionally went below 5 ug/m^3. The major exception was in the samples taken on January 24 and 30. 1975, most of which showed concentrations in the 10 to 15 ug/m^3 range. Wind speeds on both these days were typical for the reported data. These dates coincide with the period of the relatively high H_2S values noted earlier. Measured ambient radiation levels have been below 20 uR/hr, with values around 10 uR/hr typical.

The atmospheric opacity. as characterized by the scattering coefficient, has typically been $b_s = 0.4 \times 10^{-4}$ m^{-1}. This is about twice the scattering due to the molecules of air alone and corresponds to a surface visibility equivalent of 110 km (68 miles) if the air everywhere had the same characteristics. Frequent periods showed no measurable deviation from the Rayleigh scattering of pure air ($b_s = 0.2 \times 10^{-4}$ m^{-1}, visual range 225 km), while the infrequent worst hours showed $b_s = 0.7 \times 10^{-4}$ m^{-1} (visual range 64 km).

C. WORK SCHEDULED

Most of the activity during the forthcoming quarter will consist of continuation of the routine data acquisition described in this report. Additional activities are summarized below.

1. METEOROLOGY

As the collected data base expands, it becomes more useful for statistical analysis. Scheduled activities during the upcoming quarter will include analysis of the surface wind field on the tracts for each season studied so far, correlation of this year's measurements at the Grand Junction National Weather Service station with those of previous years to determine the representativeness of this year's measurements on the tracts, and correlation of measurements at various stations to determine whether differences in measurements between stations are random or due to definable physical phonəmena. Analysis of the February diffusion experiments will also be completed.

2. AIR QUALITY

The six and seven-day consecutive samples already taken under the trace metals program will be followed by one 15-day collection period (February 27 to March 15) in which each single-day area of the collector will be exposed for five days in order to increase the amount of sample and the corresponding sensitivity of the scheme.

3. NOISE

The first of the quarterly noise surveys of the tract is scheduled for the week of April 7, 1975. Noise surveys were not begun earlier because of the noise caused by the propane generators. This noise is subsiding rapidly as commercial power is being brought to the air quality stations.

IV. BIOLOGICAL RESOURCES

A. WORK PERFORMED

1. VEGETATION

Vegetation analysis for the quarter ending February 28, 1975, consisted primarily of reducing the data collected during the previous summer. Near the end of the quarter the data (density, cover, etc.) was keypunched in preparation for statistical computer analysis. These data are now being processed by the computer center. Phenological data collected from the ground-truth plots during the summer were also summarized.

2. TERRESTRIAL VERTEBRATES

Two bi-monthly sampling schedules were completed during the quarter, one in December and one in February. They were conducted exactly as prescribed in the terrestrial sampling program design, with one exception: the rodent live-trapping procedures were suspended in December after two nights of trapping. Although cotton batting and sufficient food were placed in the traps, mortality from exposure approached 25 percent. It was decided that this level of mortality was too high, so trapping was suspended for December and for February. This problem was not unexpected since the literature presents ample evidence of trap mortality problems during the winter.

The data obtained by the sampling procedures were reduced, summarized, and prepared as species lists by vegetation type and sampling period and as species numbers by sampling site and sampling period. There were insufficient numbers of any species to make an estimate of their density. Presumably, this will not be the case for the common species at other seasons of the year; nevertheless, the data available still provide a relative index to abundance.

The large mammal monitoring element plan was formalized and approved by the AOSS. An agreement between VTN and the Utah DWR was reached concerning DWR's hiring a biologist to do the telemetry work and to assist VTN in other capacities.

The telemetry program was initiated in February with an aerial survey of the area by VTN, Utah DWR, and BLM personnel to determine the most desirable locations for deer trapping. Jeff Grandison of the Utah DWR began the baiting program to capture deer so that telemetry units could be attached; however, no animals have yet been captured.

Work on the Fish and Wildlife Management Plan continued during the period. Several meetings were held between VTN and government agencies and revisions were made to clarify the intent of the plan, but the plan is still in the process of final review by the AOSS office.

3. TERRESTRIAL INVERTEBRATES

No sampling of terrestrial invertebrates was conducted during this period. Further collecting will be done during the third reporting period.

4. AQUATIC BIOLOGY

During the first quarter of 1975, work on the aquatic biology study consisted of field collection, laboratory analyses, literature review, and development of a computer program for calculation of diversity indices.

The tract area was visited from February 10 to February 18. Field work during this period was hindered by the condition of the river which was completely frozen at Station F-5. Between Hells Hole Canyon (F-1) and F-4, a channel from 10 to 30 feet wide was open in mid-river. The ice cover between the channel and the banks was formed in two layers separated by several inches of water. This condition made it impossible to recover the periphyton samplers placed during the previous field trip. Unsafe ice near the channel and deep water made quantitative collection difficult or impossible. Station F-2 was inaccessible because of mud and snow on the steep trail along Evacuation Creek to the river.

Qualitative collections were taken at Stations F-3 and F-4 and from a well overflow in Asphalt Wash. A two-foot square piece of windowscreen nailed to two boards was used for river collecting. The screen is held against the bottom and stones and bottom material are stirred upstream of the screen. Dislodged bottom organisms are caught by the screen.

Laboratory work included examination of algae and invertebrates from the tract area and fish from the downstream area. These fish were collected at four sites between the tracts and the Green River.

A program has been developed to reduce data on diversity indices. The information on this data will be included in the next Quarterly Report.

B. DATA SUMMARY

1. VEGETATION

Data from the first phenology collection were analyzed by computer. Copies of the computer print-outs and a species list are included in the compilation of field data.

2. TERRESTRIAL VERTEBRATES

Before rodent trapping was suspended, the three shadscale sites and the single riparian/greasewood site were each sampled for two days. The 192 trap nights resulted in the capture of 62 deer mice and four unidentified *Peromyscus*. The one rodent per 2.9 trap nights was much better capture success than anticipated, especially for the shadscale areas. Perhaps the vegetation analysis of shadscale areas will indicate that they are not as impoverished as they appear.

On the first night of trapping, 20 rodents were captured; on the second night, 46 were captured. This difference is highly significant ($P < 0.005$)* and suggests that the rodents were initially avoiding the traps to some extent. This response is typical of most wild animals confronted with a new object within their home range; however, the relatively good trap success and the seemingly rapid habituation to the traps suggests that a five-day trap period will be adequate to obtain an estimate of their density.

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*The probability that this is due to random chance alone is less than .005.

The lack of rodent diversity was surprising. Deer mice are expected to be dominant, perhaps at all sampling sites; however, other species of Peromyscus and species of Perognathus should be common on the tracts.

The bird and mammal species lists compiled show that there was slightly less species diversity, especially among mammals, as the winter progressed. Both birds and mammals seem to be active in fewer habitat types in February than in December.

As the winter progressed, animals, especially mammals, appeared to move from the riparian to the shadscale areas. This change from December to February was reflected not only in the data, but in the numb er of tracks seen in the snow. The shift was probably caused by animals moving away from the cold riparian bottom land to higher and warmer ground. The temperature differential could be as much as 10°C. between the riparian areas and adjacent shadscale areas 200 to 300 meters higher.

Probably the most significant biological event occuring on the tracts this quarter was the arrival of 1,800 sheep which are grazed in specific areas of the tracts under surface leasing agreements with the BLM, or traverse the tracts twice yearly along the main county road and Southern Canyon Road. Sheep are part of the current biotic community in the area and have been for some time; thus, their influence on the existing environment is to be assessed.

A bald eagle was seen near the White River bridge. The Utah Division of Wildlife Resources was informed of this sighting. The large mammal monitoring program continued during this quarter.

3. TERRESTRIAL INVERTEBRATES

No data were collected during this period.

4. AQUATIC BIOLOGY

With the exception of a single trout captured near the confluence with the Green Rivers, the fish in the collections all reflect the character of the White River. The trout probably entered from the Green River since the other fish taken are all adapted to turbid waters. Within the river, each species is able to find suitable habitat in the fast water of the rapids or the quieter pools and eddies. Flannelmouth suckers and bluehead suckers are the dominant fishes of the lease area in terms of biomass. With rivers changing character as they proceed downstream, the rapids and fast water common in the upper reaches of a stream give way to smooth water, with reduced current velocity at lower elevations. This changing character of the stream results in changes in population structure along its course. The Bluehead suckers and roundtail chubs (*Gila robusta*) which occur in the lease area are less common or absent in the downstream portion of the river.

The condition factor K_{SL} is a measure of the relative plumpness of a fish ($K_{SL} = \frac{\text{Weight}}{(\text{Length})^3} \times 10^4$). High K_{SL} is thought to indicate that the particular fish enjoys an equitable environment (Lagler, 1956); however, the length-weight relationship may vary with sex, age, season, and other factors.

Fourteen flannelmouth suckers from three White River stations had an average K_{SL} of 1.83. These factors generally agree with those found in the Green River, Colorado, where these fish had K_{SL} from 1.32 to 2.51. In the Colorado River, only small fish (less than 86 mm) had a factor greater than 1.50 (McDonald and Dotson 1960).

Three of the larger carp (Cyprinus carpio) had K_{SL} factors of 3.97 to 4.7. These factors are well over the average literature reports for this species (Carlander 1950).

a. Invertebrates

Since sampling during this period was qualitative, the invertebrate population cannot be discussed numerically. The change in population structure which occurs between October and February is a normal seasonal phenomena. Some of the nymphal species which occurred in autumn had matured and left the water. Traverella albertana is a large, colorful mayfly which fits this category. The adults emerge in late autumn, mate, and lay eggs in the water. The eggs do not hatch for some time, hence the absence of the nymphs. During the October collections, few stoneflies were taken; many of those captured were too small to identify. By February there were many large stonefly nymphs among the fauna. Nymphs of the last instar of Taenionema pacifica were abundant and adults emerged all during the second week of February. Although winged, the adults are apparently incapable of flight. They crawl across the ice and snow to the banks where they mate on the foliage. Eggs are laid in the water immediately but do not hatch for some time. Riffle beetles (Elmidae) follow the same pattern; nymphs of the genus Narcus appeared for the first time in the last collections.

b. Algae

Few algae were collected since algae are most abundant in the shallow areas, which were obscured by ice. Algae examined were taken incidentally during invertebrate collection. The collections were similar in structure to those taken earlier in the fall of 1974. *Spirulina subsalsa* was the only new algae collected.

C. WORK SCHEDULED

1. VEGETATION

Statistical analysis of the data collected last summer will be completed. Data interpretation will be accomplished and plans will be made for field work in the summer of 1975.

2. TERRESTRIAL VERTEBRATES

During the next quarter, the April bi-monthly sampling schedule will be conducted as prescribed in the terrestrial sampling design. The April sample will include the first operation of the large-rodent trapping grids. This procedure will assess the density of these animals on all primary sampling sites and will provide the necessary information to validate the trapping transects done on the other sampling sites.

Data on the abundance of reptiles and amphibians will be collected for the first time in April, 1975 along selected transects. These organisms should be emerging from hibernation by then. April will also be the first sampling period for birds which are summer residents on the tracts.

The continuation of the telemetry program is scheduled for the next quarter. Trapping of deer, mountain lions, coyotes, and bobcats will be intensified to take advantage of the improving weather. It is planned to have transmitters installed on the majority of the test animals by April, 1975.

The Fish and Wildlife Management Plan has been sent to the Area Oil Shale Supervisor and will be finalized during the third quarter.

3. TERRESTRIAL INVERTEBRATES

Further collecting of species will continue during the next quarter.

4. AQUATIC BIOLOGY

Bi-monthly sampling and analyses will continue through the third quarter. Additional methods will be employed in the fishery study to provide for thorough sampling. Periphyton samples will be submitted to a laboratory for chlorophyll analyses.

A continuing effort is being made to obtain species-level identification keys for the invertebrates encountered. Since there is a wide variation in ecological tolerance among species, it is important to identify the organisms to the lowest taxon practical. Many immature forms have not been associated with adults; hence, it is impossible to confirm identification. Existing keys are widely scattered in the literature and are gradually being accumulated.

A standard reporting format is being developed for use in subsequent reports. The new format should substantially reduce the time required for recording and reporting information.

Literature Cited

Carlander, Kenneth D. 1950. Handbook of Fishery Biology. Ia. State Univ. Press

Lagler, Carl F. 1956. Freshwater Fishery Biology. W.C. Brown Co. Dubuque, Ia.

McDonald, D.B. and P.A. Dotson 1960. Fishery investigations of the Glen Canyon and Flaming Gorge impoundment areas. Utah St. Dept. Fish and Game Info. Bull. 60-3.

V. GEOLOGY AND SOILS

A. WORK COMPLETED

Preliminary cross sections traversing the tracts have been constructed to illustrate the relative positions of the ground water surface and stratigraphic horizons (see Figures 6 and 7). The geology beneath the tracts appears to be remarkably uniform stratigraphically and structurally as revealed by the cross sections developed to date. No soils work was done during this quarter due to adverse weather conditions and prevailent snow cover.

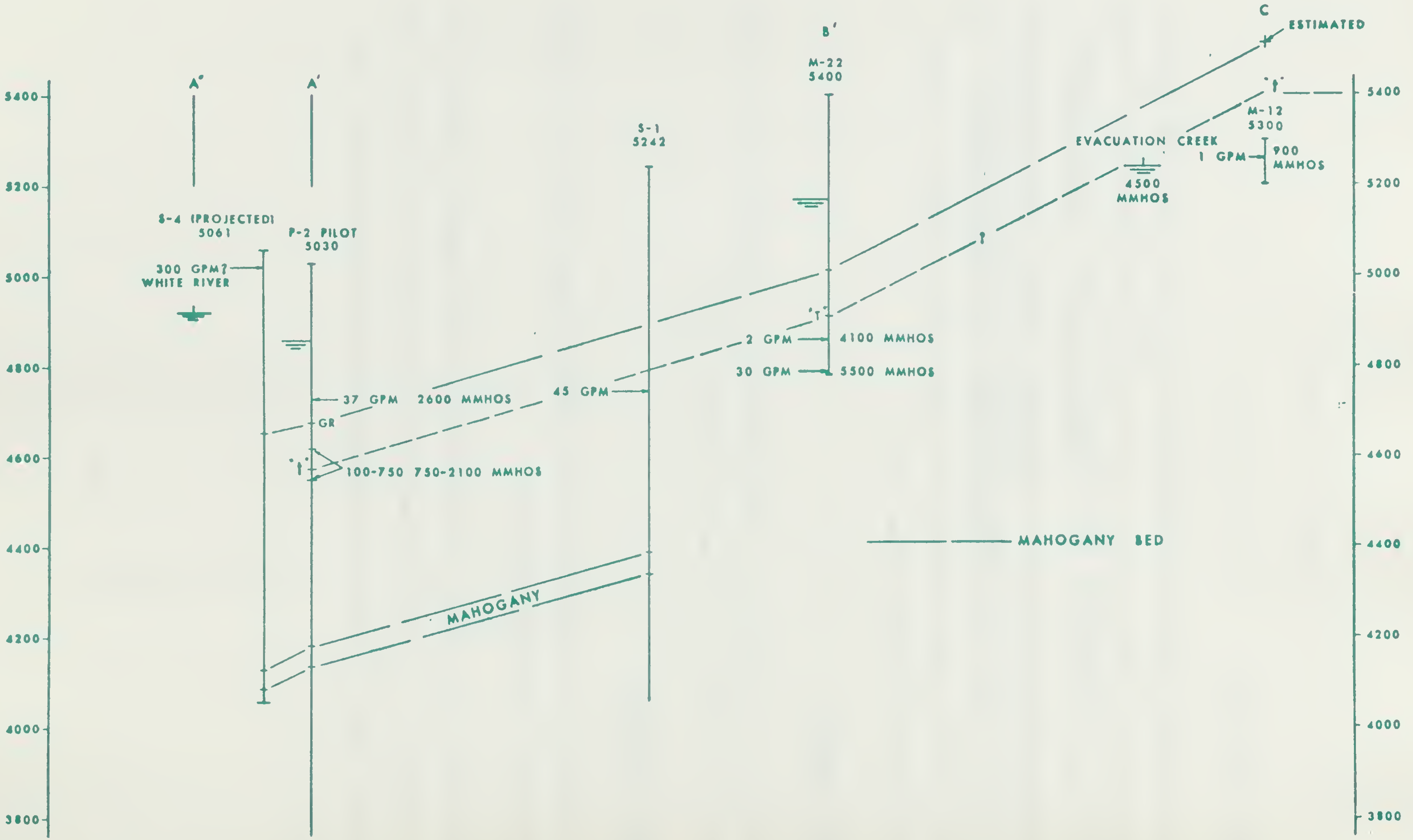
B. DATA SUMMARY

The geologic field data was unavailable for inclusion in this report. It will be included in the next quarterly report.

C. WORK SCHEDULED

Summarization of the geologic field data has begun and will continue throughout the following quarter.

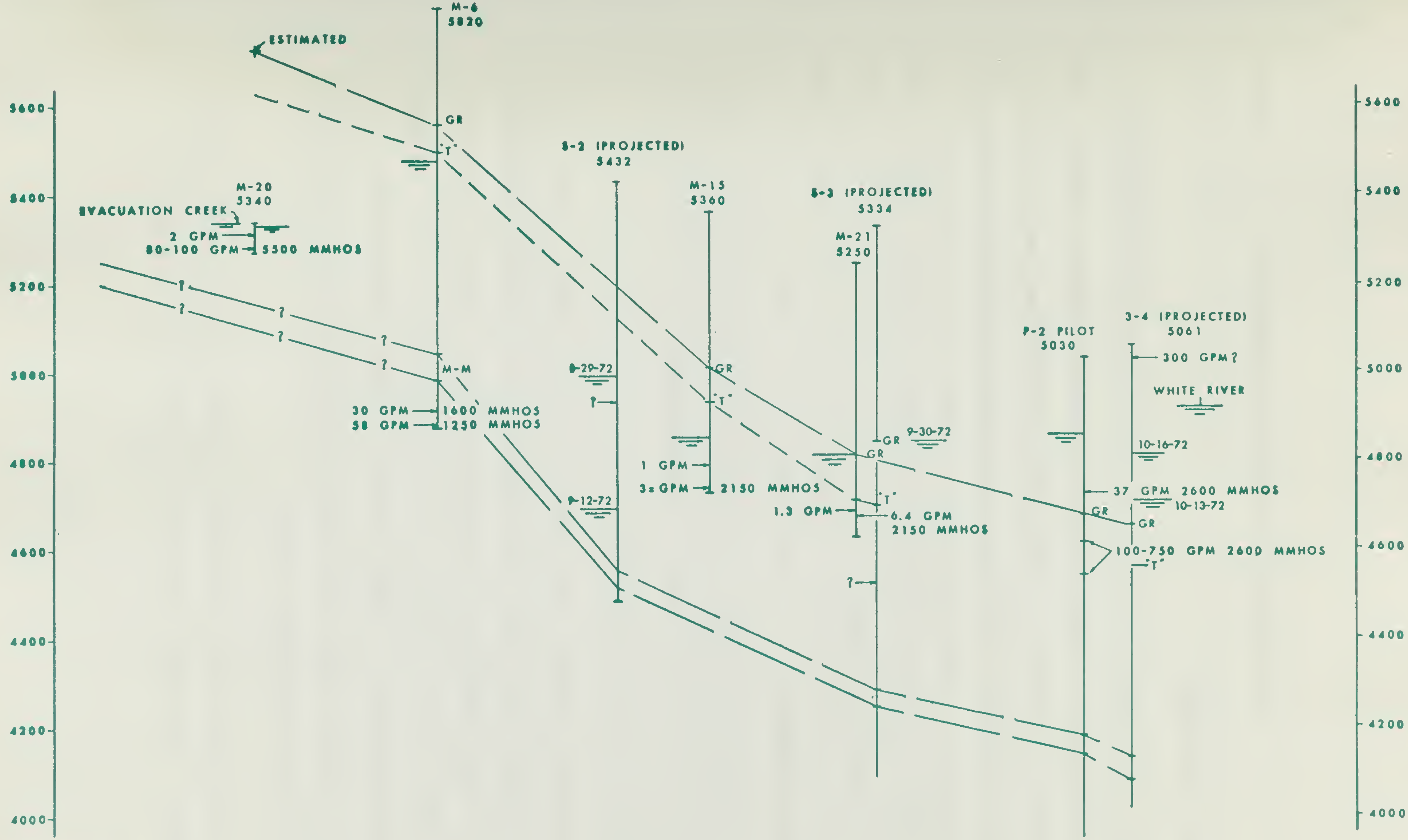
Data necessary to develop a description of the regional geology is being compiled. A comprehensive bibliography is being prepared and geophysical logs of boreholes on and around the tracts have been ordered.



TRACTS U-a and U-b
PRELIMINARY CROSS-SECTION #1

PREPARED BY FUGRO, INC.

FIGURE 6



TRACTS U-a and U-b
PRELIMINARY CROSS-SECTION #2

PREPARED BY FUGRO, INC.

FIGURE 7

VI. HISTORIC AND SCIENTIFIC RESOURCES

A. WORK COMPLETED

Because of inclement weather, no new fieldwork was conducted during the period covered by this quarterly report. During this period, however, a laboratory analysis was made of the recovered specimens (cultural and paleontological) and the paleontological consultant made one site visit to collect a few samples of the large mammal fossils discussed in the previous Quarterly Report.

B. DATA SUMMARY

The information provided in the last Quarterly Report is still basically applicable since no new information was obtained due to winter weather conditions.

The cultural resource consultant, Dr. David Madsen, Utah State Archaeologist, has stated that some of the artifacts recovered are of a type common to a prehistoric Great Plains culture (ca. 1000-1200 A.D.) but unique to the Uintah Basin. It is thought by some archaeologists to have existed in the northeast Utah area. Similar artifacts have been found previously only in the Great Salt Lake and Bear River areas.

A BYU entomologist has submitted a report on the fossil insect specimens. The report describes the fossils as valuable to research on prehistoric insects. The fossil insect record is poorly understood at this time.

C. WORK SCHEDULED

The cultural and paleontological consultants are continuing field investigations and laboratory analysis. Both consultants expect to finish field investigations around the end of April.

The cultural resource consultant has begun to prepare the description of historical resources in the tract area. This is being coordinated by Dr. Stanford Layton, managing editor of the Utah Historical Quarterly. The archaeological literature research and preparation of the general prehistory of the Uintah Basin has been undertaken by Michael Berry, Assistant State Archaeologist.

VII. GEOLOGIC EXPLORATION PROGRAM

A. WORK COMPLETED

The nine-hole exploratory drilling program was completed January 19, 1975. Two holes started during the previous period were completed and seven more were drilled.

Cleveland-Cliffs Iron Company (CCIC) personnel supervised the handling of the core. After removal from the core barrel, it was measured, logged, wrapped and sealed in plastic, boxed, and shipped to a CCIC sample preparation facility in Rifle, Colorado. As the core was logged, emphasis was placed on visual observation of rock competency. Physical features, such as fractures and parting planes, were recorded in detail.

During the period, approximately 3,200 feet of 3 1/2-inch diameter core was slabbed and nearly 2,400 Fischer assay samples were prepared. The Colorado School of Mines Research Institute (CSMRI) has completed about 1,600 Fischer assay analyses and sent the results to CCIC. Laboratory work has also begun at CSMRI on extractable alumina analyses from spent shale. In addition, Ute Research Lab, Ft. Duchesne, Utah, was contracted to perform trace element analyses on the material obtained from the exploratory drilling program.

During the period, all rock mechanics samples were delivered to the U.S. Bureau of Mines Mining Research Laboratory in Denver. Nearly all required tests were completed on the material obtained from the pilot test holes (Holes P-1 through P-4) and work proceeded on material obtained from the nine exploratory drill holes.

B. DATA SUMMARY

Drilling performance for the exploratory program is summarized in Table 4.

TABLE 4

EXPLORATORY DRILLING PROGRAM SUMMARY

HOLE #	TD	CORED INTERVAL	CORE RECOVERED	CORE LOST	% RECOVERY
X-1	1,140	270.0	268.8	1.2	99.6
X-2	766	305.8	292.6	13.2	95.7
X-3	591	269.9	269.7	0.2	99.9
X-4	958	298.0	272.6	25.4	91.5
X-5	936	283.9	282.4	1.5	99.5
X-6	805	295.0	295.0	0.0	100.0
X-9	1,068	252.0	249.1	2.9	98.8
X-10	1,093	256.1	255.6	0.5	99.8
X-11	1,023	331.5	324.7	6.8	97.9
	8,380	2,562.2	2,510.5	51.7	98.0

The record of the geophysical logging program showing parameters tested at each hole is presented in Table 5.

C. WORK SCHEDULED

Most of the activities included in the exploratory drilling program will be completed during the forthcoming quarter. Fischer assay, extractable alumina, and trace element analyses will be performed on the rest of the core samples. Rock mechanics testing will be completed also and existing drill holes will be gravel-packed and cemented.

The data obtained during the drilling program will be compiled into a geologic report. The preliminary mine plan will be completed by Cleveland-Cliffs personnel.

TABLE 5

GEOPHYSICAL LOGGING RECORD - PILOT TEST AND EXPLORATORY DRILL HOLES

HOLE:	P-1	P-2	P-3	P-4	X-1	X-2	X-3	X-4	X-5	X-6	X-9	X-10	X-11
Schlumberger													
Compensated Formation Density	X												
Compensated Neutron	X												
Laterolog with Gamma Ray	X												
Temperature	X												
Caliper							X						
Birdwell													
Density and Caliper	X	X	X	X	X	X	X*	X	X	X	X	X	X
3-D Velocity	X	X	X	X	X	X	X	X	X	X	X	X	X
Electric Log (Self Potential & Resistivity)		X	X	X	X	X	X	X	X	X	X	X	X
Nuclear (Gamma Ray)		X	X	X	X	X	X	X	X	X	X	X	X
Temperature					X	X	X	X	X	X	X	X	X
Spinner					X	X	X	X	X	X	X	X	X
Velocity					X	X	X	X	X	X	X	X	X

*Density Only

VIII. REVEGETATION STUDIES

A. WORK PERFORMED

Eleven plant species indigenous to the oil shale lease lands are presently being tested in the greenhouse for future use in revegetation of disturbed lands on the lease tracts. Several species being tested show rapid rates of germination and seedling establishment. It is thought that some of these species should be well enough established to be out-planted this spring. The following shrub species are being grown from seed:

TABLE 6

SHRUB TEST SPECIES

Shadscale	4 different ecotypes
Winterfat	3 different ecotypes
Tall Rabbitbrush	1 different ecotype
Greasewood	2 different ecotypes
Big Sagebrush	1 different ecotype
Cuneate Saltbush	2 different ecotypes
Fourwing Saltbush	4 different ecotypes
Rubber Rabbitbrush	1 different ecotype
Spineless Hopsage	1 different ecotype

Two grass species collected near the oil shale lands, western wheatgrass and Indian ricegrass, are also being evaluated.

Since the project began in January, 1975, it was too late to collect large amounts of seed. Results are encouraging, however, in spite of the fact the seed was collected late in the season.

In addition to the germination experiments, work has been initiated on vegetative propogation of several of these species. There are definite advantages to the use of cuttings because their growth rate is considerably faster than that of plants grown from seed. The following species have been studied for their feasibility of vegetative propogation: shadscale, winterfat, greasewood, big sagebrush, black sagebrush, cuneate saltbush, spineless hopsage and fourwing saltbush.

In our efforts to make contact with individuals working with native shrubs, staff members have attended two very informative conventions this winter: "Disturbed Land Reclamation and Use in the Southwest" sponsored by the University of Arizona in January and the annual convention of the Society for Range Management held in February. These two conventions were extremely beneficial because staff members were able to exchange ideas on the plants intended for use and how these plants are most easily propogated. Since returning, a number of scientific papers have been received and correspondence has been established with persons who are actively engaged in native shrub research.

B. DATA SUMMARY

Plants have been seeded in various rooting tubes and to date results indicate the larger tubes yield better results. Plants growing in them are slightly larger than those growing in the small tubes. Plants have been seeded in 1,035 tubes according to the distribution shown in Table 7. The first plantings were made on February 7, 1975. Greasewood, fourwing saltbush, cuneate saltbush, winterfat, tall rabbitbrush, spineless hopsage and big sagebrush were planted at that time. All of the species germinated with the exception of the spineless hopsage. It appears that the seed collected was of very low quality or that conditions for germination were not met. Since this past summer was extremely dry, it is probable that the seed was of low quality. The following numbers of plants have germinated in the greenhouse:

TABLE 7

GERMINATION RESULTS OF PLANT SEEDING PROGRAM
(AS OF MARCH 20, 1975)

Species Seeded	No. Tubes Planted	No. Plants	Height in cm
Greasewood	250	247	10
Tall rabbitbrush	210	208	7
Big sagebrush	200	200	7
Winterfat	40	38	10
Shadscale	150	14	5
Cuneate saltbush	125	11	3
Fourwing saltbush	60	10	10
TOTAL	1,035	728	

The shadscale, cuneate saltbush, and fourwing saltbush are still germinating, so these plants will probably increase in number with time.

Experiments have been made with numerous methods of seed sizing and soaking to improve germinability. Greasewood has been caused to germinate within one hour after soaking the seeds in water overnight and then heating them. The seedling emergence counts after 48 hours were 67 plants per 450 seeds planted, or a 15 percent emergence for the unsoaked seeds; the soaked seeds yielded 159 plants for 450 seeds planted, for a 35 percent emergence after two days. The application of this pre-germination treatment is very significant when applied to seeds to be planted in the field during the revegetation study program.

Work has also been done to improve the germination of shadscale using seed sizing treatments. Preliminary results indicate that the use of seed screens allows for separation of the larger seed from the smaller seed, thereby improving the percentage of filled seed. The larger seed contains in excess of 30 percent filled seed and the smaller seeds are approximately 10 percent filled seed. Testing on the germinability of these seeds will continue. This seed treatment practice appears to be of promise for application in future shrub seedlings.

Variable success has been achieved in the rooting of greenwood and shadscale cuttings. The rooting abilities are being tested in a mist chamber and also in root-watered peat pellets.

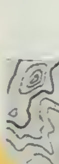
Big sagebrush and greasewood cuttings were started at the same time. They appeared to break dormancy quickly and put on considerable new growth. The greasewood looked good, but once the stored food reserves were exhausted it started to die, failing to produce any roots at all. The big sagebrush appears to have exhausted its food reserves and to be dying off also.

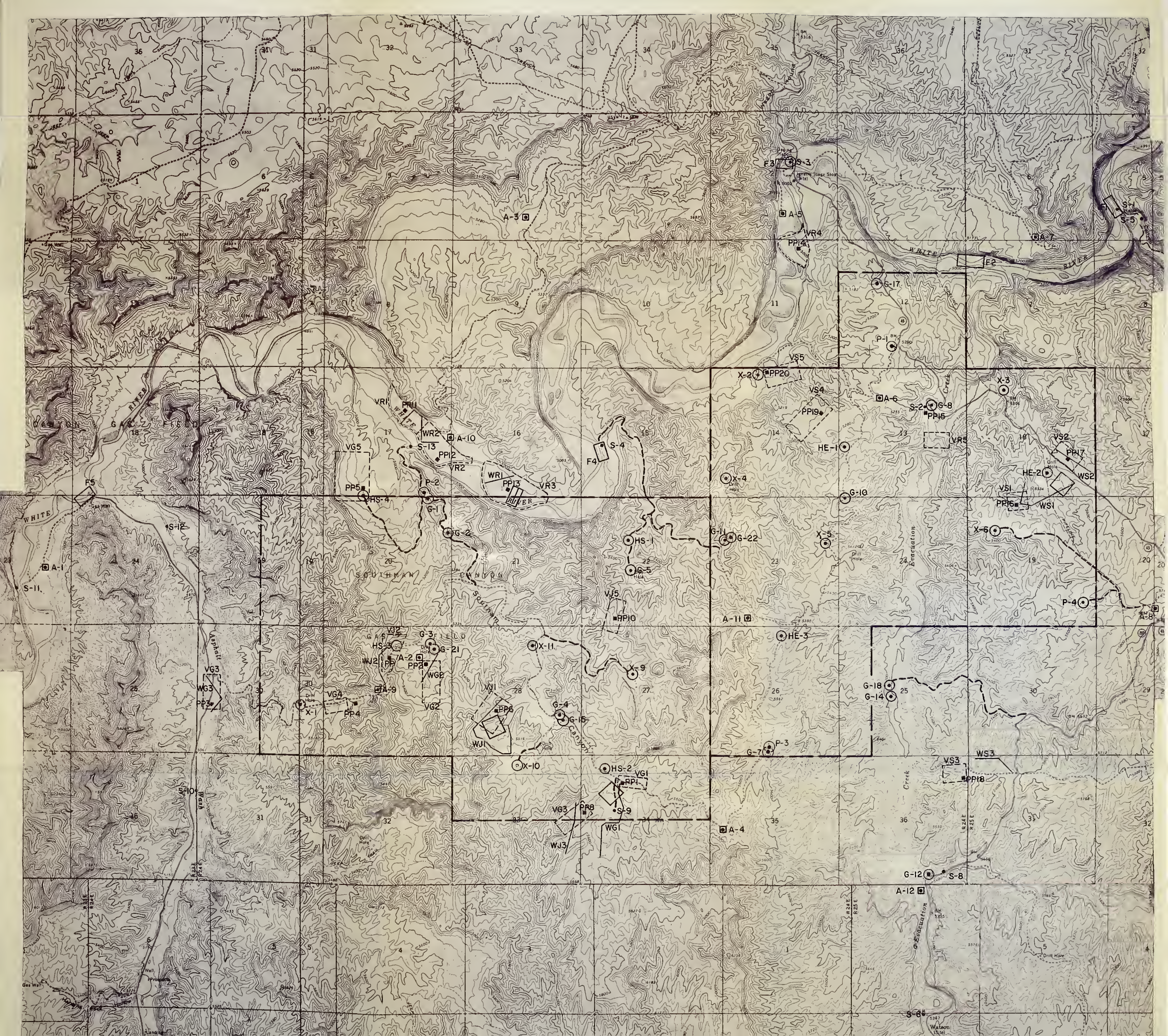
The black sagebrush planted has broken dormancy but no rooting has been observed. Winterfat planted on the same date has broken dormancy; and rootlets are rapidly developing from the root primodia.

C. WORK SCHEDULED

In late March a trip was planned to the Uintah Basin to collect additional plant material. A staff member will be working full time this spring on the production of these plants in preparation for use this spring. This should provide sufficient plant materials to establish the necessary revegetation studies.

The limited results obtained to date indicate that native shrubs are relatively easy to establish in large rooting tubes. These plants can be started from seed or from stem cuttings. Eleven plant species indigenous to the oil shale lease tracts are being grown in soils collected on or near the tracts. Soils were collected in the Green River Formation near Station A-7. and in the Uintah Formation near Well G-18. These plants should be mature enough for planting later this year. Plans presently call for the use of numerous other shrub species growing in the vicinity of the tracts. Further results of these experiments will be reported in the future.




WHITE RIVER
DRAGON GAS FIELD
SOUTHMAN CANYON
Southman Canyon
GAS FIELD
Asphalt Wash
Evacuation Creek
Creek
A-1
A-2
A-3
A-4
A-5
A-6
A-7
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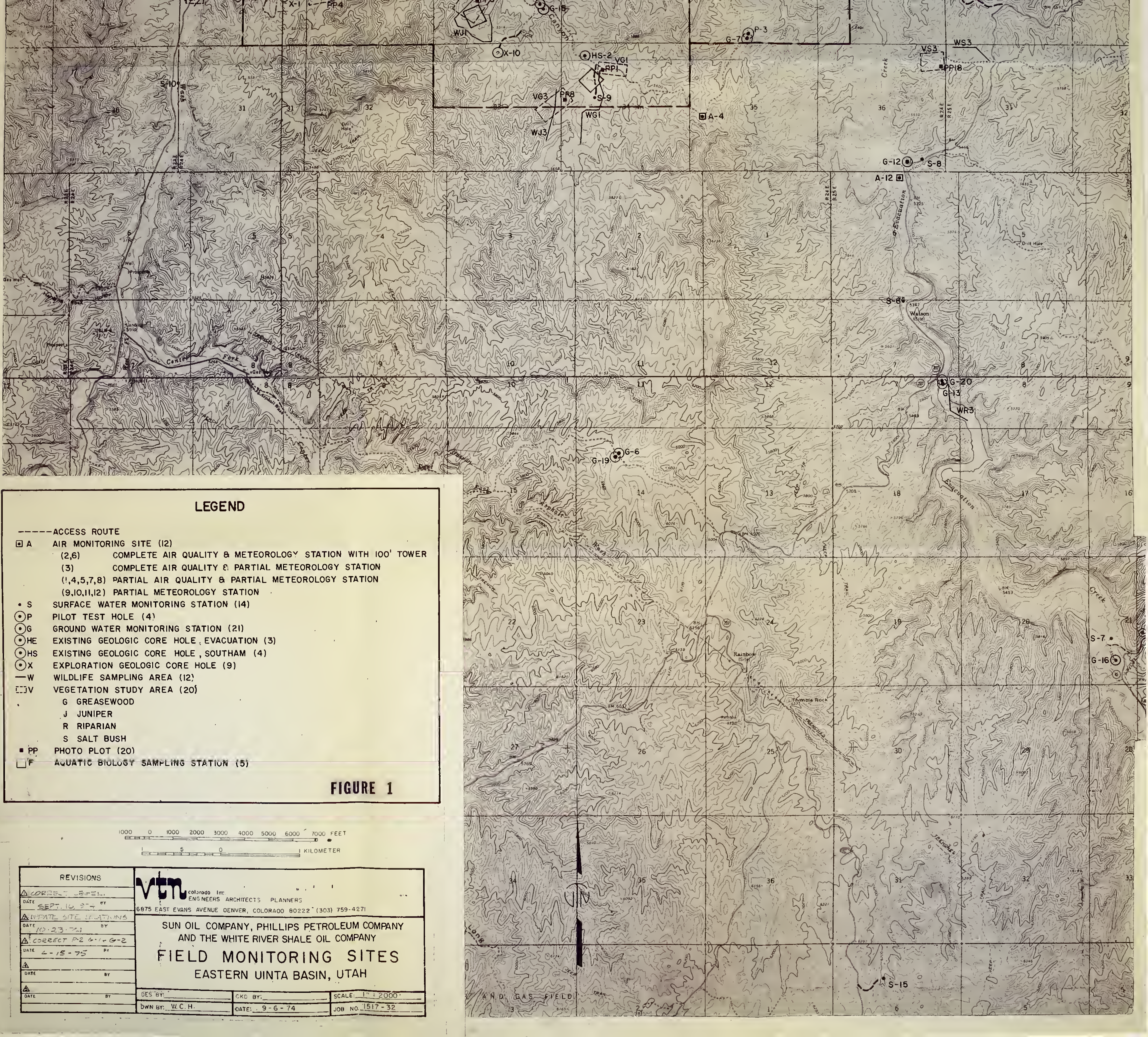

LEGEND

-----	ACCESS ROUTE
⊡ A	AIR MONITORING SITE (12)
	(2,6) COMPLETE AIR QUALITY & METEOROLOGY STATION WITH 100' TOWER
	(3) COMPLETE AIR QUALITY & PARTIAL METEOROLOGY STATION
	(1,4,5,7,8) PARTIAL AIR QUALITY & PARTIAL METEOROLOGY STATION
	(9,10,11,12) PARTIAL METEOROLOGY STATION
• S	SURFACE WATER MONITORING STATION (14)
⊙ P	PILOT TEST HOLE (4)
⊙ G	GROUND WATER MONITORING STATION (21)
⊙ HE	EXISTING GEOLOGIC CORE HOLE, EVACUATION (3)
⊙ HS	EXISTING GEOLOGIC CORE HOLE, SOUTHAM (4)
⊙ X	EXPLORATION GEOLOGIC CORE HOLE (9)
— W	WILDLIFE SAMPLING AREA (12)
⬚ V	VEGETATION STUDY AREA (20)
	G GREASEWOOD
	J JUNIPER
	R RIPARIAN
	S SALT BUSH
▪ PP	PHOTO PLOT (20)
☐ F	AQUATIC BIOLOGY SAMPLING STATION (5)

FIGURE 1

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

REVISIONS	
△ CORRECT LEGEND	
DATE SEPT. 16, 974	BY
△ UPDATE SITE LOCATIONS	
DATE 10·23·74	BY
△ CORRECT P-2 G-1 & G-2	
DATE 4-15-75	BY
△	
DATE	BY
△	
DATE	BY

vtn colorado Inc.
ENGINEERS ARCHITECTS PLANNERS
6875 EAST EVANS AVENUE DENVER, COLORADO 80222 (303) 759-4271

SUN OIL COMPANY, PHILLIPS PETROLEUM COMPANY
AND THE WHITE RIVER SHALE OIL COMPANY

FIELD MONITORING SITES

EASTERN UINTA BASIN, UTAH

DES BY:	CKD BY:	SCALE: 1" = 2000'
DWN BY: W.C.H.	DATE: 9-6-74	JOB NO. 1517-32

CHAMPION CLASP NO. 97 10 x 13

ER'S CARD

o.2 c.3

seline Data

	OFFICE	DATE RETURNED

(Continued on reverse)